

## CLAIMS

What is claimed is:

1. An adaptive focusing method of a static part in which an optical disc is not driven and a pickup head operates in an optical disc drive, the adaptive focusing method comprising:

allowing the pickup head to fall from the optical disc to a minimum value of a focus drive signal during a focus search operation;

allowing the pickup head to rise close to the optical disc and to a maximum allowable value of the focus drive signal when a signal reflected from the optical disc is detected when the pickup head reaches the minimum value of the focus drive signal; and

allowing the pickup head to fall from the optical disc to a minimum allowable value of the focus drive signal when the pickup head reaches the maximum allowable value of the focus drive signal.

2. The adaptive focusing method of claim 1, wherein the maximum allowable value of the focus drive signal is within a maximum value of the focus drive signal during the focus search operation, and the minimum allowable value of the focus drive signal is within the minimum value of the focus drive signal during the focus search operation.

3. The adaptive focusing method of claim 1, further comprising:  
repeating the rise of the pickup head to the maximum allowable value of the focus drive signal and the fall of the pickup head to the minimum allowable value of the focus drive signal after the fall of the pickup head to the minimum allowable value of the focus drive signal.

4. The adaptive focusing method of claim 1, wherein a vertical deviation of the pickup head to the maximum allowable value of the focus drive signal after the reflected signal is detected is set to be a fixed value.

5. The adaptive focusing method of claim 1, wherein a vertical deviation of the pickup head to the maximum allowable value of the focus drive signal after the reflected signal is detected is set in proportion to a time interval from the reflection of the signal from a surface of the optical disc to the reflection of the signal from a recording layer of the optical disc.

6. The adaptive focusing method of claim 1, wherein the reflected signal is a focus error signal that is a portion of a signal detected by the pickup head.

7. The adaptive focusing method of claim 1, wherein the reflected signal is a sum signal of signals detected by the pickup head.

8. The adaptive focusing method of claim 6, wherein a vertical deviation of the pickup head to the maximum allowable value of the focus drive signal after the reflected signal is detected is set by detecting a peak-to-peak time of the focus error signal.

9. The adaptive focusing method of claim 6, wherein the static part performs the focus search operation prior to a start of focusing or in an initialization operation, and checks whether the optical disc is loaded, a type of optical disc, a number of layers of the optical disc and adjust a gain coefficient of the focus error signal, using the signal reflected.

10. An adaptive focusing method of a dynamic part in which a focus is deviated when both a disc driver and a pickup head operate in an optical disc drive of an optical disc, the adaptive focusing method comprising:

allowing the pickup head to rise from a lowermost position of a surface of the optical disc and to a maximum allowable value of a focus drive signal when a signal reflected from the optical disc is detected; and

allowing the pickup head to fall from the optical disc to a minimum allowable value of the focus drive signal when the pickup head reaches the maximum allowable value of the focus drive signal.

11. The adaptive focusing method of claim 10, further comprising allowing the pickup head to stand-by at the minimum allowable value of the focus drive signal for a predetermined period of time before the rise of the pickup head to the maximum allowable value of the focus drive signal.

12. The adaptive focusing method of claim 11, wherein when a previous state of the optical disc drive is not an on-focus state, the pickup head stands-by at the minimum allowable value of the focus drive signal so as not to touch the optical disc.

13. The adaptive focusing method of claim 10, wherein the lowermost position of the surface of the optical disc corresponds to the minimum allowable value of the focus drive signal.

14. The adaptive focusing method of claim 10, wherein the maximum allowable value of the focus drive signal is within a maximum value of the focus drive signal during a focus search operation, and the minimum allowable value of the focus drive signal is within a minimum value of the focus drive signal during the focus search operation.

15. The adaptive focusing method of claim 10, wherein a vertical deviation of the pickup head to the maximum allowable value of the focus drive signal after the reflected signal is detected is set to be a fixed value.

16. The adaptive focusing method of claim 10, wherein a vertical deviation of the pickup head to the maximum allowable value of the focus drive signal after the reflected signal is detected is set in proportional to a time interval from the reflection of the signal from the surface of the optical disc to the reflection of the signal from a recording layer.

17. The adaptive focusing method of claim 10, wherein the reflected signal is a focus error signal that is a portion of a signal detected by the pickup head.

18. The adaptive focusing method of claim 10, wherein the reflected signal is a sum signal of signals detected by the pickup head.

19. The adaptive focusing method of claim 17, wherein a vertical deviation of the pickup head to the maximum allowable value of the focus drive signal after the reflected signal is detected is adaptively set by detecting a peak-to-peak time of the focus error signal.

20. The adaptive focusing method of claim 10, wherein the rise of the pickup head to the maximum allowable value of the focus drive signal comprises:

allowing the pickup head to rise at a slower speed than a vertical deviation speed of the optical disc; and

allowing the pickup head to rise to the maximum allowable value of the focus drive signal when the signal reflected from the optical disc is detected.

21. The adaptive focusing method of claim 20, wherein the fall of the pickup head to the minimum allowable value of the focus drive signal comprises:

allowing the pickup head to fall from the optical disc to the minimum allowable value of the focus drive signal when the pickup head reaches the maximum allowable value of the focus drive signal; and

allowing the pickup head to stand-by at the minimum allowable value of the focus drive signal for a predetermined period of time when the pickup head reaches the minimum allowable value of the focus drive signal.

22. The adaptive focusing method of claim 21, further comprising:

repeating the rise of the pickup head to the maximum allowable value of the focus drive signal when the signal reflected from the optical disc is detected, the fall of the pickup head to the minimum allowable value of the focus drive signal when the pickup head reaches the minimum allowable value of the focus drive signal, and the stand-by of the pickup head at the minimum allowable value of the focus drive signal when the pickup head reaches the minimum allowable value of the focus drive signal, after the rise of the pickup head to the maximum allowable value of the focus drive signal.

23. An adaptive focusing apparatus of an optical disc drive of an optical disc, comprising:

a disc driver rotating the optical disc;

a pickup head;

a focus servo controller that moves the pickup head to an optimal focus point;

a reflected signal detector detecting a signal reflected from the optical disc by the pickup head; and

a signal processor preventing spikes between a surface of the optical disc and the pickup head in response to the signal reflected and generating a focus drive signal for the focus servo controller using an adaptive focus search algorithm comprising a static part and a dynamic part to reduce a focus search time.

24. The adaptive focusing apparatus of claim 23, wherein the disc driver comprises a spindle motor and the focus servo controller comprises a focus actuator, and wherein the static part is applied before a focusing starts or in an initialization operation, and, during the static part, the spindle motor of the disc driver is motionless and a swing margin of the focus actuator is adaptive.

25. The adaptive focusing apparatus of claim 24, wherein the static part allows the pickup head to fall from the optical disc to a minimum value of a focus drive signal during a focus search operation, allows the pickup head to rise close to the optical disc when the pickup head reaches the minimum value of the focus drive signal and to a maximum allowable value of the focus drive signal when the signal is reflected from the optical disc, and allows the pickup head to fall from the optical disc to a minimum allowable value of the focus drive signal when the pickup head reaches the maximum allowable value of the focus drive signal.

26. The adaptive focusing apparatus of claim 25, wherein the allowing of the pickup head to rise to the maximum allowable value of the focus drive signal and the allowing of the pickup head to fall to the minimum allowable value of the focus drive signal are repeated a predetermined number of times in consideration of a stability of the focusing.

27. The adaptive focusing apparatus of claim 25, wherein a vertical deviation of the pickup head to the maximum allowable value of the focus drive signal after the reflected signal is detected is set to be a fixed value.

28. The adaptive focusing apparatus of claim 25, wherein, after the signal reflected is detected, a vertical deviation of the pickup head to the maximum allowable value of the focus drive signal is set in proportion to a time interval from the reflection of the signal from the surface of the optical disc to the reflection of the signal from a recording layer.

29. The adaptive focusing apparatus of claim 25, wherein the reflected signal is a focus error signal that is a portion of a signal detected by the pickup head.

30. The adaptive focusing apparatus of claim 25, wherein the reflected signal is a sum signal of signals detected by the pickup head.

31. The adaptive focusing apparatus of claim 29, wherein a vertical deviation of the pickup head to the maximum allowable value of the focus drive signal after the reflected signal is detected is set by detecting a peak-to-peak time of the focus error signal.

32. The adaptive focusing apparatus of claim 24, wherein the swing margin is set to be an absolute margin to prevent damage to the optical disc drive.

33. The adaptive focusing apparatus of claim 24, wherein the swing margin is calculated every pass of the pickup head depending on an actual position of a center of S-curves of the signal reflected or an actual position of a focus point.

34. The adaptive focusing apparatus of claim 24, wherein in the static part, the signal processor does not allow the spindle motor to rotate, and checks a type of optical disc, a number of layers and adjusts a gain coefficient of a focus error signal.

35. The adaptive focusing apparatus of claim 23, wherein the dynamic part is used when the optical disc rotates in synchronization with a speed of the spindle motor of the disc driver and when a focus is deviated due to outer disturbances in a normal operation, instability of the optical disc drive, or damage to the optical disc.

36. The adaptive focusing apparatus of claim 35, wherein the pickup head moves to an initial position being a lowermost position of the surface of the optical disc to search for a focus point, where an actual value of the focus drive signal is the lowermost position of the surface of the optical disc.

37. The adaptive focusing apparatus of claim 36, wherein the dynamic allows the pickup head to rise from the initial position and to a maximum allowable value of the focus drive signal when the signal reflected from the optical disc is detected, and allows the pickup head to fall from the optical disc to a minimum allowable value of the focus drive signal when the pickup head reaches the maximum allowable value of the focus drive signal.

38. The adaptive focusing apparatus of claim 37, wherein the dynamic part allows the pickup head to stand-by at the minimum allowable value of the focus drive signal for a predetermined period of time before the rise of the pickup head.

39. The adaptive focusing apparatus of claim 37, wherein the dynamic part allows the pickup head to stand-by at the minimum allowable value of the focus drive signal when the pickup head reaches the minimum allowable value of the focus drive signal after the fall of the pickup head.

40. The adaptive focusing apparatus of claim 23, wherein the dynamic part of the focus search algorithm uses information about a revolution time of a spindle motor, a current time, and a moment of a safe lowermost portion of the surface of the disc to synchronize the moment of S-curves and the lowermost position of the surface of the disc.

41. The adaptive focusing apparatus of claim 23, wherein the dynamic part of the adaptive focus search algorithm comprises a 0-state, a 1-state, and a 2-state, and a 3-state, wherein in the 0-state, a time delay is created to prevent false conditions caused by false S-curves of a focusing error signal (FES) due to unpredictable relative positions of the pickup head and the surface of the disc, the 1-state forms a slowly ascending region of a focus drive signal (FOD) with a rising velocity of at least predetermined times less than a rising velocity of the pickup head, the 2-state forms an ascending region of the FOD, and the 3-state forms descending and flat horizontal regions of the FOD.

42. The adaptive focusing apparatus of claim 41, wherein after the 3-state, the 3-state is switched to the 2-state, and the states are repeated in an alternating order to search for the focus point.